WHAT IS CLAIMED IS:

1. A system for increasing throughput and channel capacity of an optical network comprising;

a plurality of transmitter data processors receiving a plurality data channel inputs for transmission over said optical network, said transmitter data processors being time division multiplexed by said plurality of data channel inputs into a plurality of temporal and spatial data streams;

a plurality of optical sources being directly modulated by said plurality of temporal data streams;

a plurality of polarization modulators receiving said plurality of temporally modulated optical sources and spatially modulating the polarization states of the received optical sources by said plurality of spatial data streams from said plurality of transmitter data processors;

wavelength division multiplexer for wavelength division multiplexing data streams received from said plurality of polarization modulators;

an optical fiber cable receiving and transmitting said plurality of wavelength division multiplexed data streams;

a wavelength division demultiplexer for wavelength division demultiplexing said plurality of wavelength division multiplexed data streams transmitted by said fiber-optics cable;

a plurality polarization demodulators for polarization demodulating said plurality of data streams received from said wavelength division demultiplexer;

a plurality of detectors for direct detection of a plurality of temporal data streams from said plurality of polarization demodulators;

a plurality of receiver data processors for demultiplexing said plurality of temporal data streams from said plurality of detectors and a plurality of spatial data streams received from said plurality of polarization demodulators into a plurality of data output channels;

whereby channel capacity and throughput of said optical communications network is substantially increased.

2. The system according to Claim 1 in which said plurality of polarization modulators are digital modulators.

3. The system according to Claim 2 in which said digital modulators produce a plurality of polarization levels to map to $2^M$ distinct states where M equals the number of polarization levels.

4. The system according to Claim 1 in which said plurality of polarization demodulators are Stokes parameter estimators having a control loop for tracking polarization state changes; and a decision logic block.

5. The system according to Claim 1 including one or more optical amplifiers in said fiber-optical cable to extend the transmission distance of said fiber-optics cable.

6. The system according to Claim 1 including a multiple channel optical wavelength channel multiple cross-connect inserted in said fiber-optics cable for reusing each wavelength channel multiple times for connecting additional transmitters and receivers.

7. The system according to Claim 1 in which said plurality of optical sources are directly modulated at the inputs by said plurality of temporal data streams.

8. The system according to Claim 1 which said plurality optical sources are indirectly temporally modulated in amplitude at the outputs by said plurality of polarization modulators by said plurality of data streams from said plurality of transmitter data processors.

9. The system according to Claim 8 in which said plurality of optical sources are indirectly temporally modulated in phase at the outputs by said plurality of polarization modulators by said plurality of data streams from said plurality of transmitter data processors.

10. The system according to Claim 8 in which said plurality of optical sources are indirectly temporally modulated

in frequency at the outputs by said plurality of polarization modulators by said plurality of data streams from said plurality of transmitter data processors.

11. The system according to Claim 8 in which said plurality of polarization modulators are electro-optics modulators.

12. The system according to Claim 1 which said plurality of detectors for direct detection of a plurality of temporal data streams from said a plurality of polarization demodulators are photo-detectors.

13. The system according to Claim 8 in which said plurality of detectors coherently optically demodulate outputs received from said plurality of polarization demodulators.

14. The system according to Claim 13 in which said coherent optical demodulator is an optical source using homodyne demodulation.

15. The system according to Claim 13 in which said coherent optical demodulator is a local optical source using heterodyne demodulation.

16. The system according to Claim 8 including optical amplifiers inserted in said fiber-optical cable for extended transmission distances.

17. The system according to Claim 8 including an optical

wavelength cross-connect inserted in said fiber-optic transmission cable to reuse each wavelength multiple times for connecting transmitters and receivers.

18. The system according to Claim 1 in which said network is a fiber-optics transmission ring network.

19. The system according to Claim 18 in which;

said ring network includes a plurality of add/drop nodes each operating at a specific wavelength with L time division multiplexed channels;

said plurality of add/drop nodes being between said wavelength division multiplexer and said wavelength division demultiplexer.

20. The system according to Claim 19 in which each of said plurality of add/drop nodes has a receiver/transmitter pair.

21. The system according to Claim 8 in which said network is a fiber-optics transmission ring network.

22. The system according to Claim 21 in which;

said ring network includes a plurality of add/drop nodes each operating at a specific wavelength with L time division multiplexed channels;

said plurality of add/drop nodes being between said wavelength division multiplexer and said wavelength division demultiplexer.

23. The system according to Claim 22 in which each of said plurality of add/drop nodes has a receiver/transmitter pair.

24. The system according to Claim 1 in which said optical network is a star coupled network having a plurality of nodes connected by a star coupler.

25. The system according to Claim 24 in which said plurality of nodes comprise;

a transmitter/receiver data processor;

an optical source receiving temporal data from said transmitter/receiver data processor;

a polarization modulator receiving spatial data from said transmitter/receiver data processor, said polarization modulator being connected to said star coupler for distribution of a wavelength multiplexed signals to all of said plurality of other nodes;

a wavelength demultiplexer for extracting a wavelength division multiplexed signal;

a polarization demodulator receiving an output from said wavelength demultiplexer;

a photo-detector receiving an output from said polarization demodulator;

a coupler for distributing a wavelength division multiplexed signal;

whereby each of said nodes distributes a signal at an optical wavelength to the star coupler and it demultiplexes wavelengths from the star coupler, demodulates the polarization and photo-detects received time division multiplexed data stream of spatial and temporal data for delivery to said transmitter/receiver data processor.

26. The system according to Claim 8 in which said optical network is a star coupled network having a plurality of nodes connected by a star coupler.

27. The system according to Claim 26 in which said plurality of nodes comprise;

a transitter/receiver data processor;

an optical source receiving temporal data from said transmitter/receiver data processor;

a polarization modulator receiving spatial data from said transmitter/receiver data processor and;

said polarization modulator being connected to said star coupler for distribution of a wavelength multiplexed signals to all of said plurality of other nodes;

a wavelength demultiplexer for extracting a wavelength division multiplexed signal;

a polarization demodulator receiving an output from said wavelength demultiplexer;

a photo-detector receiving an output from said polarization demodulator;

a coupler for distributing a wavelength division multiplexed signal;

whereby each of said nodes distributes a signal at an optical wavelength to the star coupler and it demultiplexes wavelengths from the star coupler, demodulates the polarization and photo-detects received time division multiplexed data stream of spatial and temporal data for delivery to said transmitter/receiver data processor.

28. A method of increasing transmissions through an optical communication network comprising;

time division multiplexing a plurality of data channel inputs into a plurality of temporal and spatial data streams;

temporally modulating in intensity a plurality of optical sources by said plurality of data streams;

spatially modulating in polarization said plurality of optical sources by said plurality of data streams;

time division demultiplexing said plurality of data streams in receiver data processors;

whereby channel capacity and throughput of said optical communications network is substantially increased.

29. The method according to Claim 28 in which said

wavelength division multiplexing of said plurality of polarization modulated data streams comprises;

transmitting said wave division multiplexed data streams over a fiber-optic transmission line;

demultiplexing said wave division multiplexed data streams received over said fiber-optic transmission line;

polarization demodulating said plurality of demultiplexed data streams;

detecting and directly demodulating said plurality of data streams.June 29, 2001

30. The method according to Claim 28 in which said plurality of data streams are polarization modulated by a digital modulator.

31. The method according to Claim 28 including cross-connecting multiple sets of optical wavelength channels to allow each optical wavelength channel to be used multiple times.

32. The method according to Claim 28 wherein temporal modulation by temporal data stream comprises indirect modulation of said optical sources in amplitude, phase and/or frequency by said temporal data stream.

33. The method according to Claim 29 wherein detecting comprises coherent optical detection using homodyne demodulation.

34. The method according to Claim 29 wherein detecting comprises coherent optical detection using heterodyne demodulation.

35. The method according to Claim 28 wherein said time division multiplexing of a plurality of channels of an optical communication network comprises time division multiplexing channels of a wavelength division multiplexed ring network.

36. The method according to Claim 28 wherein said time division multiplexing of a plurality of channels of an optical communication network comprises time division multiplexing channels of a star coupled optical communication network.

37. The method according to Claim 28 wherein said time division multiplexing of plurality of channels of an optical communication network comprises a fiber-optic data bus network.

38. The method according to Claim 37 in which said data bus network comprises multiple network interface units operating at a plurality of wavelengths.